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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XF329

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Low-Energy Geophysical Survey in the Northeastern Pacific Ocean

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; Issuance of an Incidental Harassment Authorization.

SUMMARY: In accordance with the regulations implementing the Marine Mammal Protection Act (MMPA) as amended, notification is hereby given that NMFS has issued an incidental harassment authorization (IHA) to the Scripps Institution of Oceanography (SIO) to incidentally harass, by Level A and Level B harassment, marine mammals during a low-energy marine geophysical survey in the northeastern Pacific Ocean.

DATES: This Authorization is valid from September 22, 2017, through September 19, 2018.

FOR FURTHER INFORMATION CONTACT: Jordan Carduner, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *www.nmfs.noaa.gov/pr/permits/incidental/research.htm*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq*.) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

NMFS has defined "negligible impact" in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

The MMPA states that the term "take" means to harass, hunt, capture, kill or attempt to harass, hunt, capture, or kill any marine mammal.

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. §§ 4321 *et seq.*) and NOAA Administrative Order (NAO) 216-6A, NMFS must review our proposed action (*i.e.*, the issuance of an incidental harassment authorization) with respect to potential impacts on the human environment. Accordingly, NMFS prepared an Environmental Assessment (EA) to consider the environmental impacts associated with the issuance of the IHA to SIO. We reviewed all comments submitted in response to the *Federal Register* notice for the proposed IHA (82 FR 39276; August 17, 2017) prior to concluding our NEPA process and deciding whether or not to issue a Finding of No Significant Impact (FONSI). NMFS concluded that issuance of an IHA to SIO would not significantly affect the quality of the human environment and prepared and issued a FONSI in accordance with NEPA and NAO 216-6A. NMFS's EA and FONSI for this activity are available on our web site at: *http://www.nmfs.noaa.gov/pr/permits/incidental*.

Summary of Request

On March 20, 2017, NMFS received a request from SIO for an IHA to take marine mammals incidental to conducting a low-energy marine geophysical survey in the northeastern Pacific Ocean. On July 5, 2017, we deemed SIO's application for authorization to be adequate and complete. SIO's request is for take of a small number of 27 species of marine mammals by Level B harassment and Level A harassment. Neither SIO nor NMFS expects mortality to result from this activity, and, therefore, an IHA is appropriate. The planned activity is not expected to exceed one year, hence, we do not expect subsequent MMPA incidental harassment authorizations would be issued for this particular activity.

Description of Specified Activity

A detailed description of SIO's low-energy geophysical survey is provided in the *Federal Register* notice for the proposed IHA (82 FR 39276; August 17, 2017). Since that time, no changes have been made to the planned activities. Therefore, a detailed description is not provided here. Please refer to that *Federal Register* notice for the description of the specific activity.

Comments and Responses

NMFS published a notice of proposed IHA in the *Federal Register* on August 17, 2017 (82 FR 39276). During the 30-day public comment period, NMFS received a comment letter from the Marine Mammal Commission (Commission) as well as one comment from a member of the general public. NMFS has posted the comments online at: *http://www.nmfs.noaa.gov/pr/permits/incidental*. NMFS addresses any comments specific to SIO's application related to the statutory and regulatory requirements or findings that NMFS must make under the MMPA in order to issue an Authorization. The following is a summary of the public comments and NMFS' responses.

Comment 1: A comment received from a member of the general public expressed concern that the survey would result in the deaths of marine mammals.

Response: NMFS does not anticipate that SIO's survey will result in the deaths of marine mammals and the authorization does not permit serious injury or mortality of marine mammals.

Comment 2: The Commission expressed concerns regarding SIO's method to estimate the extent of the Level A and Level B harassment zones and the numbers of marine mammal takes. The Commission stated that the model is not the best available science because it assumes spherical spreading, a constant sound speed, and no bottom interactions for surveys in deep water. In light of their concerns, the Commission recommended that NMFS require SIO, in

collaboration with Lamont-Doherty Earth Observatory of Columbia University (L-DEO) (which performed the modeling of Level A and Level B harassment zones) to re-estimate the Level A and Level B harassment zones and associated takes of marine mammals using both operational (including number/type/spacing of airguns, tow depth, source level/operating pressure, operational volume) and site-specific environmental (including sound speed profiles, bathymetry, and sediment characteristics at a minimum) parameters.

Response: NMFS acknowledges the Commission's concerns about LDEO's current modeling approach for estimating Level A and Level B harassment zones and takes. SIO's application (LGL, 2017) and the *Federal Register* notice of the proposed IHA (82 FR 39276; August 17, 2017) describe the applicant's approach to modeling Level A and Level B harassment zones. The model L-DEO currently uses does not allow for the consideration of environmental and site-specific parameters as requested by the Commission.

L-DEO's application (LGL, 2017) describes their approach to modeling Level A and Level B harassment zones. In summary, L-DEO acquired field measurements for several array configurations at shallow, intermediate, and deep-water depths during acoustic verification studies conducted in the northern Gulf of Mexico in 2007 and 2008 (Tolstoy *et al*., 2009). Based on the empirical data from those studies, L-DEO developed a sound propagation modeling approach that predicts received sound levels as a function of distance from a particular airgun array configuration in deep water. For this survey, L-DEO modeled Level A and Level B harassment zones based on the empirically-derived measurements from the Gulf of Mexico calibration survey (Appendix H of NSF-USGS 2011). For deep water (>1000 m), L-DEO used the deep-water radii obtained from model results down to a maximum water depth of 2,000 m (Figure 2 and 3 in Appendix H of NSF-USGS 2011); the radii for intermediate water depths

(100–1,000 m) were derived from the deep-water ones by applying a correction factor (multiplication) of 1.5, such that observed levels at very near offsets fall below the corrected mitigation curve (Fig. 16 in Appendix H of the NSF-USGS 2011).

In 2015, L-DEO explored the question of whether the Gulf of Mexico calibration data described above adequately informs the model to predict exclusion isopleths in other areas by conducting a retrospective sound power analysis of one of the lines acquired during L-DEO's seismic survey offshore New Jersey in 2014 (Crone, 2015). NMFS presented a comparison of the predicted radii (*i.e.*, modeled exclusion zones) with radii based on in situ measurements (*i.e.*, the upper bound [95th percentile] of the cross-line prediction) in a previous notice of issued Authorization for Lamont-Doherty (see 80 FR 27635, May 14, 2015, Table 1). Briefly, the anlysis presented in Crone (2015), specific to the survey site offshore New Jersey, confirmed that in-situ, site specific measurements and estimates of 160 dB and 180 dB isopleths collected by the hydrophone streamer of the *R/V Marcus Langseth* in shallow water were smaller than the modeled (*i.e.*, predicted) zones for two seismic surveys conducted offshore New Jersey in shallow water in 2014 and 2015. In that particular case, Crone's (2015) results showed that L-DEO's modeled 180 dB and 160 dB zones were approximately 28 percent and 33 percent smaller, respectively, than the in-situ, site-specific measurements, thus confirming that L-DEO's model was conservative in that case.

The following is a summary of two additional analyses of in-situ data that support L-DEO's use of the modeled Level A and Level B harassment zones zones in this particular case. In 2010, L-DEO assessed the accuracy of their modeling approach by comparing the sound levels of the field measurements acquired in the Gulf of Mexico study to their model predictions (Diebold *et al.*, 2010). They reported that the observed sound levels from the field measurements

fell almost entirely below the predicted mitigation radii curve for deep water (greater than 1,000 m; 3280.8 ft) (Diebold *et al*., 2010). In 2012, L-DEO used a similar process to model distances to isopleths corresponding to the isopleths corresponding to Level A and Level B harassment thresholds for a shallow-water seismic survey in the northeast Pacific Ocean offshore Washington State. L-DEO conducted the shallow-water survey using the same airgun configuration planned for the surveys considered in this IHA (*i.e*., 6,600 in^3) and recorded the received sound levels on both the shelf and slope using the *Langseth's* 8 km hydrophone streamer. Crone *et al*. (2014) analyzed those received sound levels from the 2012 survey and confirmed that in-situ, site specific measurements and estimates of the 160 dB and 180 dB isopleths collected by the *Langseth's* hydrophone streamer in shallow water were two to three times smaller than L-DEO's modeling approach had predicted. While the results confirmed bathymetry's role in sound propagation, Crone *et al*. (2014) were also able to confirm that the empirical measurements from the Gulf of Mexico calibration survey (the same measurements used to inform L-DEO's modeling approach for the planned surveys in the southwest Pacific Ocean) overestimated the size of the exclusion and buffer zones for the shallow-water 2012 survey off Washington State and were thus precautionary, in that particular case.

NMFS continues to work with L-DEO to address the issue of incorporating site-specific information for future authorizations for seismic surveys. However, L-DEO's current modeling approach (supported by the three data points discussed previously) represents the best available information for NMFS to reach determinations for this IHA. As described earlier, the comparisons of L-DEO's model results and the field data collected in the Gulf of Mexico, offshore Washington State, and offshore New Jersey illustrate a degree of conservativeness built into L-DEO's model for deep water, which NMFS expects to offset some of the limitations of

the model to capture the variability resulting from site-specific factors. Based upon the best available information (*i.e.*, the three data points, two of which are peer-reviewed, discussed in this response), NMFS finds that the Level A and Level B harassment zone calculations are appropriate for use in this particular IHA.

L-DEO has conveyed to NMFS that additional modeling efforts to refine the process and conduct comparative analysis may be possible with the availability of research funds and other resources. Obtaining research funds is typically accomplished through a competitive process, including those submitted to U.S. Federal agencies. The use of models for calculating buffer and exclusion zone radii and for developing take estimates is not a requirement of the MMPA incidental take authorization process. Furthermore, NMFS does not provide specific guidance on model parameters nor prescribe a specific model for applicants as part of the MMPA incidental take authorization process at this time, although we do review methods to ensure adequate for prediction of take. There is a level of variability not only with parameters in the models, but also the uncertainty associated with data used in models, and therefore, the quality of the model results submitted by applicants. NMFS considers this variability when evaluating applications and the take estimates and mitigation measures that the model informs. NMFS takes into consideration the model used, and its results, in determining the potential impacts to marine mammals; however, it is just one component of the analysis during the MMPA authorization process as NMFS also takes into consideration other factors associated with the activity (*e.g.*, geographic location, duration of activities, context, sound source intensity, etc.).

Comment 3: The Commission expressed concern that the method used to estimate the numbers of takes, which summed fractions of takes for each species across project days, does not account for and negates the intent of NMFS' 24-hour reset policy.

NMFS Response: We appreciate the Commission's ongoing concern in this matter. Calculating predicted takes is not an exact science and there are arguments for taking different mathematical approaches in different situations, and for making qualitative adjustments in other situations. We believe, however, that the methodology used for take calculation in this IHA remains appropriate and is not at odds with the 24-hour reset policy the Commission references.

Comment 4: The Commission expressed concern that information was missing in NMFS's *Federal Register* notice of proposed IHA (82 FR 39276; August 17, 2017) and SIO's application, including operating frequency of the multibeam echosounder (MBES) and sub-bottom profiler (SBP) and information regarding densities, Level A daily ensonified areas, and number of days of activities that informed NMFS's analysis.

NMFS Response: We appreciate the Commission pointing out the deficiencies in the *Federal Register* notice of proposed IHA (82 FR 39276; August 17, 2017). In response to the Commisison's concerns we have done the following, as recommended by the Commission: (1) used the Dall's porpoise density derived from Beaufort sea states (BSS) of 0–5 rather than 0–3; (2) ensured that pinniped densities are based on the best available information; and (3) ensured the estimated numbers of Level A and B harassment takes are correct based on the relevant densities, daily ensonified areas, and number of days of activities (Table 8). The MBES will operate at 12 kilohertz (kHz) and the SBP will operate at 3.5 kHz.

Description of Marine Mammals in the Area of Specified Activities

Section 4 of the IHA application summarizes available information regarding status and trends, distribution and habitat preferences, and behavior and life history, of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS' Stock Assessment Reports (SAR; *www.nmfs.noaa.gov/pr/sars/*), and more general

information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS' website (*www.nmfs.noaa.gov/pr/species/mammals/*).

Table 1 lists all species with expected potential for occurrence in the northeastern Pacific Ocean and summarizes information related to the population or stock, including regulatory status under the MMPA and Endangered Species Act (ESA) and potential biological removal (PBR), where known. For taxonomy, we follow Committee on Taxonomy (2016). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS' SARs). While no mortality is anticipated or authorized here, PBR and annual serious injury and mortality from anthropogenic sources are included here as gross indicators of the status of the species and other threats.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS' stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS' U.S. Pacific SARs (*e.g.*, Carretta *et al*., 2017). All values presented in Table 1 are the most recent available at the time of publication and are available in the 2017 SARs (Carretta *et al.*, 2017), available online at: *www.nmfs.noaa.gov/pr/sars*, except where noted otherwise.

Table 1. Marine Mammals that Could Occur in the Project Area.

Species	Stock	ESA/MMPA status; Strategic (Y/N)[1]	Stock abundance[2] (CV, Nmin, most recent abundance	PBR[4]	Relative Occurrence in Project Area

			survey)[3]		
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)					
Family: Balaenopteridae					
North Pacific right whale[5] (*Eubalaena japonica*)	Eastern North Pacific	E/D; Y	31	0.1	Rare
Gray whale[5] (*Eschrichtius robustus*)	Eastern North Pacific	-/-; N	20,990 (0.05; 20,125; 2011)	3.1	Common in nearshore areas, rare elsewhere
Humpback whale[6] (*Megaptera novaeangliae*)	California/Oregon/Washington	E/T / D; N	1,918 (0.03; 1,876; 2014)	11	Common in nearshore areas, rare elsewhere
Minke whale (*Balaenoptera acutorostrata)*	California/Oregon/Washington	-/-; N	636 (0.72; 369; 2014)	3.5	Rare
Sei whale (*Balaenoptera borealis)*	Eastern N Pacific	E/D; Y	519 (0.4; 374; 2014)	0.75	Rare
Fin whale (*Balaenoptera physalus*	California/Oregon/Washington	E/D; Y	9,029 (0.12; 8,127; 2014)	81	Common
Blue whale (*Balaenoptera musculus)*	Eastern N Pacific	E/D; Y	1,647 (0.07; 1,551; 2011)	2.3	Rare
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family: Physeteridae					
Sperm whale (*Physeter macrocephalus*)	California/Oregon/Washington	E/D; Y	2,106 (0.58; 1,332; 2014)	2.7	Common
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family: Kogiidae					
Pygmy sperm whale (*Kogia breviceps*)	California/Oregon/Washington	-/-; N	4,111 (1.12; 1,924; 2014)	19	Rare
Dwarf sperm whale (*Kogia sima*)	California/Oregon/Washington	-/-; N	unknown (unknown; unknown; 2014)	Undet.	Rare
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family delphinidae					
Killer whale (*Orcinus orca*)	West coast transient	-/-; N	243 (n/a; 243 ;2009)	2.4	Rare
	Eastern North Pacific offshore	-/-; N	240 (0.49; 162; 2014)	1.6	Rare
False killer whale[7] (*Pseudorca crassidens*)	Hawaii Pelagic	-/-; N	1,540 (0.66; 928; 2010)	9.3	Rare
Short-finned pilot whale (*Globicephala macrorhynchus*)	California/Oregon/ Washington	-/-; N	836 (0.79; 466; 2014)	4.5	Rare
Harbor porpoise (*Phocoena phocoena)*	Northern Oregon/ Washington Coast	-/-; N	21,487 (0.44; 15,123; 2011)	151	Abundant
	Northern California / Southern Oregon	-/-; N	35,769 (0.52; 23,749; 2011)	475	Abundant
Dall's porpoise	California/Oregon/ Washington	-/-; N	25,750 (0.45;	172	Abundant

(*Phocoena dalli)*			17,954; 2014)		
Bottlenose dolphin (*Tursiops truncatus*)	California/Oregon/Washington Offshore	-/-; N	1,924 (0.54; 1,255; 2014)	11	Rare
Striped dolphin (*Stenella coeruleoala*)	California/Oregon/Washington	-/-; N	29,211 (0.2; 24,782; 2014)	238	Rare
Risso's dolphin (*Grampus griseus*)	California/Oregon/Washington	-/-; N	6,336 (0.32; 4,817; 2014)	46	Common
Short-beaked common dolphin (*Delphinus delphis*)	California/Oregon/Washington	-; N	969,861 (0.17; 839,325; 2014)	8,393	Common
Pacific white-sided dolphin (Lagenorhynchus obliquidens)	California/Oregon/Washington	-; N	26,814 (0.28; 21,195; 2014)	191	Abundant
Northern right whale dolphin (*Lissodelphis borealis*)	California/Oregon/Washington	-; N	26,556 (0.44; 18,608; 2014)	179	Common
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family:Ziphiidae					
Cuvier's beaked whale (*Ziphius cavirostris*)	California/Oregon/Washington	-/-; N	6,590 (0.55; 4,481; 2008)	45	Common
Baird's beaked whale *(Berardius bairdii)*	California/Oregon/Washington	-; N	847 (0.81; 466; 2008)	4.7	Common
Mesoplodont beaked whales[8]	California/Oregon/Washington	-/-; N	694 (0.65; 389; 2008)	3.9	Rare
Order Carnivora – Superfamily Pinnipedia					
Family Otariidae (eared seals and sea lions)					
California sea lion (*Zalophus californianus*)	U.S.	-; N	296,750 (n/a; 153,337; 2011)	9,200	Rare
Steller sea lion (*Eumetopias jubatus*)	Eastern U.S.	-; N	41,638 (n/a; 41,638; 2015)	2,498	Common in nearshore areas, rare elsewhere
Family Phocidae (earless seals)					
Harbor seal [9] (*Phoca vitulina*)	Oregon/Washington Coast	-; N	24,732 (unk; unk; n/a)	Unknown	Common in nearshore areas, rare elsewhere
Northern elephant seal (*Mirounga angustirostris*)	California breeding	-; N	179,000 (n/a; 81,368; 2010)	4,882	Common in nearshore areas, rare elsewhere
Northern fur seal (*Callorhinus ursinus*)	California	-; N	14,050 (n/a; 7,524; 2013)	451	Common in nearshore areas, rare elsewhere

[1] Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR (see footnote 3) or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] Abundance estimates from Carretta *et al.* (2017) unless otherwise noted.

[3] CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For certain stocks, abundance estimates are actual counts of animals and there is no associated CV. The most recent abundance survey that is reflected in the abundance estimate is presented; there may be more recent surveys that have not yet been incorporated into the estimate.
[4] Potential biological removal (PBR), defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population size (OSP).
[5] Values for gray whale and North Pacific right whale are from Muto *et al.* (2016).
[6] Humpback whales in the survey area could originate from either the ESA threatened Mexico DPS or from the ESA endangered Central America DPS.
[7] NMFS does not have a defined stock for false killer whales off the West Coast of the U.S. as they are considered uncommon visitors to the area; any false killer whales observed off the West Coast of the U.S. would likely be part of the eastern North Pacific population. Of the stocks defined by NMFS, the Hawaii Pelagic stock is the most likely to include individuals in the eastern North Pacific population.
[8] Includes the following species: Blainville's beaked whale (*M. densirostris*), Perrin's beaked whale (*M. perrini*), Lesser beaked whale (*M. peruvianus*), Stejneger's beaked whale (*M. stejnegeri*), Gingko-toothed beaked whale (*M. gingkodens*), and Hubbs' beaked whale (*M. carlhubbsi*).
[9] The most recent abundance estimate is from 1999. This is the best available information, but because this abundance estimate is >8 years old, there is no current estimate of abundance available for this stock.

All species that could potentially occur in the planned survey area are included in Table 1. However, as described below, the spatial occurrence of the North Pacific right whale and dwarf sperm whale are such that take is not expected to occur for these species. The North Pacific right whale is one of the most endangered species of whale in the world (Carretta *et al.*, 2017). Only 82 sightings of right whales in the entire eastern North Pacific were reported from 1962 to 1999, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell *et al.* 2001). Most sightings in the past 20 years have occurred in the southeastern Bering Sea, with a few in the Gulf of Alaska (Wade *et al.* 2011). Despite many miles of systematic aerial and ship-based surveys for marine mammals off the coasts of Washington, Oregon and California over several years, only seven documented sightings of right whales were made from 1990 to 2000 (Waite *et al.* 2003). Because of the small population size and the fact that North Pacific right whales spend the summer feeding in high latitudes, the likelihood that the planned survey would encounter a North Pacific right whale is discountable. Along the U.S. west coast, no at-sea sightings of dwarf sperm whales have ever been reported despite numerous vessel surveys of this region (Barlow 1995; Barlow and Gerrodette 1996;

Barlow and Forney 2007; Forney 2007; Barlow 2010, Barlow 2016). Therefore, based on the best available information, we believe the likelihood of the survey encountering a dwarf sperm whale is discountable. SIO requested authorization for the incidental take of dwarf sperm whales (the request was for a combined two takes of pygmy and/or dwarf sperm whales). However as we have determined the likelihood of take of dwarf sperm whales is discountable, we do not authorize take of dwarf sperm whales. Thus, the North Pacific right whale and dwarf sperm whale are not discussed further in this document.

A detailed description of the of the species likely to be affected by SIO's survey, including brief introductions to the species and relevant stocks as well as available information regarding population trends and threats, and information regarding local occurrence, were provided in the *Federal Register* notice for the proposed IHA (82 FR 39276; August 17, 2017); since that time, we are not aware of any changes in the status of these species and stocks; therefore, detailed descriptions are not provided here. Please refer to that *Federal Register* notice for these descriptions. Please also refer to NMFS' website for generalized species accounts: *www.nmfs.noaa.gov/pr/species/mammals/*.

Potential Effects of Specified Activities on Marine Mammals and their Habitat

The effects of underwater noise from marine geophysical survey activities have the potential to result in behavioral harassment and, in a limited number of instances, auditory injury (PTS) of marine mammals in the vicinity of the action area. The *Federal Register* notice of proposed IHA (82 FR 39276; August 17, 2017) included a discussion of the effects of anthropogenic noise on marine mammals and their habitat, therefore that information is not repeated here; please refer to that *Federal Register* notice for that information. No instances of serious injury or mortality are expected as a result of SIO's survey activities.

Estimated Take

This section provides an estimate of the number of incidental takes authorized through this IHA, which will inform both NMFS' consideration of whether the number of takes is "small" and the negligible impact determination.

Harassment is the only type of take expected to result from these activities. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Authorized takes are primarily by Level B harassment, as use of the seismic airguns have the potential to result in disruption of behavioral patterns for individual marine mammals. There is also some potential for auditory injury (Level A harassment) to result, primarily for high frequency cetaceans and phocid pinnipeds. Auditory injury is unlikely to occur for low- and mid-frequency species given very small modeled zones of injury for those species. The mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable. As described previously, no mortality is anticipated or authorized for this activity. Below we describe how the take is estimated.

Described in the most basic way, we estimate take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence

of marine mammals within these ensonified areas; and (4) and the number of days of activities. Below, we describe these components in more detail and present the exposure estimate and associated numbers of take authorized.

Acoustic Thresholds

Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment for non-explosive sources – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.*, 2007, Ellison *et al.* 2011). Based on the best available science and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider to fall under Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 decibedl (dB) re 1 micropascal (μPa) root mean square (rms) for continuous (*e.g.* vibratory pile-driving, drilling) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (*e.g.*, seismic airguns) or intermittent (*e.g.*, scientific sonar) sources. SIO's planned activity includes the use of impulsive seismic sources. Therefore, the 160 dB re 1 μPa (rms) criteria is applicable for analysis of level B harassment.

Level A harassment for non-explosive sources - NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2016) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). The Technical Guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience changes in their hearing sensitivity for all underwater anthropogenic sound sources, reflects the best available science, and better predicts the potential for auditory injury than does NMFS' historical criteria.

These thresholds were developed by compiling and synthesizing the best available science and soliciting input multiple times from both the public and peer reviewers to inform the final product, and are provided in Table 3 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2016 Technical Guidance, which may be accessed at: *www.nmfs.noaa.gov/pr/acoustics/guidelines.htm*. As described above, SIO's planned activity includes the use of intermittent and impulsive seismic sources.

To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al*., 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al*. (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.*, low-frequency cetaceans). Subsequently, NMFS (2016) described generalized

hearing ranges for these marine mammal hearing groups (Table 2). Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al*. (2007) retained. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

- Low-frequency cetaceans (mysticetes): generalized hearing is estimated to occur between approximately 7 hertz (Hz) and 35 kHz, with best hearing estimated to be from 100 Hz to 8 kHz;
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz, with best hearing from 10 to less than 100 kHz;
- High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus*; including two members of the genus *Lagenorhynchus*, on the basis of recent echolocation data and genetic data): generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz.
- Pinnipeds in water; Phocidae (true seals): generalized hearing is estimated to occur between approximately 50 Hz to 86 kHz, with best hearing between 1-50 kHz;
- Pinnipeds in water; Otariidae (eared seals): generalized hearing is estimated to occur between 60 Hz and 39 kHz, with best hearing between 2-48 kHz.

The pinniped functional hearing group was modified from Southall *et al*. (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended

frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä et al., 2006; Kastelein et al., 2009; Reichmuth and Holt, 2013).

Table 2. Marine Functional Mammal Hearing Groups and Their Generalized Hearing Ranges.

Hearing Group	Generalized Hearing Range*
Low frequency (LF) cetaceans (baleen whales)	7Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, Lagenorhynchus cruciger and L. australis)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (*i.e.*, all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.*, 2007) and PW pinniped (approximation).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2016) for a review of available information. Twenty four marine mammal species (all cetaceans) have the reasonable potential to co-occur with the planned survey activities. Please refer to Table 1. Of the cetacean species that may be present, 6 are classified as low-frequency cetaceans (*i.e.*, all mysticete species), 16 are classified as mid-frequency cetaceans (*i.e.*, all delphinid and ziphiid species and the sperm whale), and 2 are classified as high-frequency cetaceans (*i.e.*, Kogia spp.).

Table 3. Thresholds Identifying the Onset of Permanent Threshold Shift in Marine Mammals.

Hearing Group	PTS Onset Thresholds	
	Impulsive*	Non-impulsive
Low-Frequency (LF) Cetaceans	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	$L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	$L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	$L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	$L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	$L_{E,PW,24h}$: 201 dB
	$L_{pk,flat}$: 232 dB	$L_{E,OW,24h}$: 219 dB

Otariid Pinnipeds (OW) (Underwater)	$L_{E,OW,24h}$: 203 dB	

Note: *Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (Lpk) has a reference value of 1 µPa, and cumulative sound exposure level (LE) has a reference value of 1µPa2s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Ensonified Area

Here, we describe operational and environmental parameters of the activity that will feed into estimating the area ensonified above the acoustic thresholds.

The planned survey would entail the use of a 2-airgun array with a total discharge of 90 cubic inches (in^3) at a tow depth of 3 meters (m). The distance to the predicted isopleth corresponding to the threshold for Level B harassment (160 dB re 1 µPa) was calculated based on results of modeling performed by LDEO. Received sound levels were predicted by LDEO's model (Diebold *et al.* 2010) as a function of distance from the airgun array. The LDEO modeling approach uses ray tracing for the direct wave traveling from the array to the receiver and its associated source ghost (reflection at the air-water interface in the vicinity of the array), in a constant-velocity half-space (infinite homogeneous ocean layer unbounded by a seafloor). In addition, propagation measurements of pulses from a 36-airgun array at a tow depth of 6 m have been reported in deep water (~1,600 m), intermediate water depth on the slope (~600–1100 m), and shallow water (~50 m) in the Gulf of Mexico in 2007–2008 (Tolstoy *et al.* 2009; Diebold *et al.* 2010). The estimated distances to the Level B harassment isopleth for the *Revelle* airgun array are shown in Table 4.

Table 4. Predicted Radial Distances from R/V Revelle 90 in^3 Seismic Source to Isopleth Corresponding to Level B Harassment Threshold.

Water depth	Predicted Distance to Threshold (160 dB re 1 µPa)
> 1000 m	448 m
100 – 1000 m	672 m

For modeling of radial distances to predicted isopleths corresponding to harassment thresholds in deep water (>1,000 m), LDEO used the deep-water radii for various Sound Exposure Levels obtained from LDEO model results down to a maximum water depth of 2,000 m (see Figure 2 in the IHA application). Radial distances to predicted isopleths corresponding to harassment thresholds in intermediate water depths (100–1,000 m) were derived by LDEO from the deep-water distances by applying a correction factor (multiplication) of 1.5, such that observed levels at very near offsets fall below the corrected mitigation curve (Fig. 16 in Appendix H of NSF-USGS 2011). LDEO's modeling methodology is described in greater detail in the IHA application (LGL 2017) and we refer to the reader to that document rather than repeating it here.

Predicted distances to Level A harassment isopleths, which vary based on marine mammal functional hearing groups (Table 2), were calculated based on modeling performed by LDEO using the Nucleus software program and the NMFS User Spreadsheet, described below. The updated acoustic thresholds for impulsive sounds (such as airguns) contained in the Technical Guidance (NMFS 2016) were presented as dual metric acoustic thresholds using both cumulative sound exposure level (SEL_{cum}) and peak sound pressure level (SPL) metrics. As dual metrics, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the two metrics is exceeded (*i.e.*, metric resulting in the largest isopleth). The SEL_{cum} metric considers both level and duration of exposure, as well as auditory weighting functions by marine

mammal hearing group. In recognition of the fact that the requirement to calculate Level A harassment ensonified areas could be more technically challenging to predict due to the duration component and the use of weighting functions in the new SEL_{cum} thresholds, NMFS developed an optional User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to facilitate the estimation of take numbers.

The values for SEL_{cum} and peak SPL for the *Revelle* airgun array were derived from calculating the modified farfield signature (Table 5). The farfield signature is often used as a theoretical representation of the source level. To compute the farfield signature, the source level is estimated at a large distance below the array (*e.g.*, 9 kilometers (km)), and this level is back projected mathematically to a notional distance of 1 m from the array's geometrical center. However, when the source is an array of multiple airguns separated in space, the source level from the theoretical farfield signature is not necessarily the best measurement of the source level that is physically achieved at the source (Tolstoy *et al.* 2009). Near the source (at short ranges, distances <1 km), the pulses of sound pressure from each individual airgun in the source array do not stack constructively, as they do for the theoretical farfield signature. The pulses from the different airguns spread out in time such that the source levels observed or modeled are the result of the summation of pulses from a few airguns, not the full array (Tolstoy *et al.* 2009). At larger distances, away from the source array center, sound pressure of all the airguns in the array stack coherently, but not within one time sample, resulting in smaller source levels (a few dB) than the source level derived from the farfield signature. Because the farfield signature does not take into account the array effect near the source and is calculated as a point source, the modified farfield signature is a more appropriate measure of the sound source level for distributed sound sources,

such as airgun arrays. Though the array effect is not expected to be as pronounced in the case of a 2-airgun array as it would be with a larger airgun array, the modified farfield method is considered more appropriate than use of the theoretical farfield signature.

Table 5. Modeled source levels using modified farfield method for R/V Revelle 90 in^3 airgun array.

Functional Hearing Group	Peak SPL_{flat}	SEL_{cum}
Low frequency cetaceans ($L_{pk,flat}$: 219 dB, $L_{E,LF,24h}$: 183 dB)	232.805 dB	206.0165 dB
Mid frequency cetaceans ($L_{pk,flat}$: 230 dB, $L_{E,MF,24h}$: 185 dB)	229.89 dB	205.9638 dB
High frequency cetaceans (**$L_{pk,flat}$**: 202 dB; $L_{E,HF,24h}$: 155 dB)	232.867 dB	206.384 dB
Phocid Pinnipeds (Underwater) ($L_{pk,flat}$: 218 dB; $L_{E,HF,24h}$: 185 dB)	232.356 dB	205.9638 dB
Otariid Pinnipeds (Underwater) ($L_{pk,flat}$: 232 dB; $L_{E,HF,24h}$: 203 dB)	224.7897 dB	206.806 dB

In order to more realistically incorporate the Technical Guidance's weighting functions over the seismic array's full acoustic band, unweighted spectrum data for the *Revelle*'s airgun array (modeled in 1 Hz bands) was used to make adjustments (dB) to the unweighted spectrum levels, by frequency, according to the weighting functions for each relevant marine mammal hearing group. These adjusted/weighted spectrum levels were then converted to pressures (µPa) in order to integrate them over the entire broadband spectrum, resulting in broadband weighted source levels by hearing group that could be directly incorporated within the User Spreadsheet (*i.e.*, to override the Spreadsheet's more simple weighting factor adjustment). Using the User Spreadsheet's "safe distance" methodology for mobile sources (described by Sivle *et al*., 2014) with the hearing group-specific weighted source levels, and inputs assuming spherical spreading propagation, a source velocity of 2.57 m/second, and shot interval of 7.78 seconds (LGL 2017), potential radial distances to auditory injury zones were then calculated for SEL_{cum} thresholds. Inputs to the User Spreadsheet are shown in Table 5. Outputs from the User Spreadsheet in the form of estimated distances to Level A harassment isopleths are shown in Table 6. As described

above, the larger distance of the dual criteria (SEL_{cum} or Peak SPL_{flat}) is used for estimating takes by Level A harassment. The weighting functions used are shown in Table 3 of the IHA application.

Table 6. Modeled radial distances (m) from R/V Revelle 90 in^3 airgun array to isopleths corresponding to Level A harassment thresholds.

Functional Hearing Group (Level A harassment thresholds)	**Peak SPL_{flat}**	**SEL_{cum}**
Low frequency cetaceans ($L_{pk,flat}$: 219 dB, $L_{E,LF,24h}$: 183 dB)	4.9	7.9
Mid frequency cetaceans ($L_{pk,flat}$: 230 dB, $L_{E,MF,24h}$: 185 dB)	1.0	0
High frequency cetaceans (**$L_{pk,flat}$**: 202 dB; $L_{E,HF,24h}$: 155 dB)	34.9	0
Phocid Pinnipeds (Underwater) ($L_{pk,flat}$: 218 dB; $L_{E,HF,24h}$: 185 dB)	5.2	0.1
Otariid Pinnipeds (Underwater) ($L_{pk,flat}$: 232 dB; $L_{E,HF,24h}$: 203 dB)	0.4	0

Note that because of some of the assumptions included in the methods used, isopleths produced may be overestimates to some degree, which will ultimately result in some degree of overestimate of Level A take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools and will qualitatively address the output where appropriate. For mobile sources, such as the planned seismic survey, the User Spreadsheet predicts the closest distance at which a stationary animal would not incur PTS if the sound source traveled by the animal in a straight line at a constant speed.

Marine Mammal Occurrence

In this section we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations.

The best available scientific information was considered in conducting marine mammal exposure estimates (the basis for estimating take). For most cetacean species, densities calculated

by Barlow (2016) were used. These represent the most comprehensive and recent density data available for cetacean species in slope and offshore waters of Oregon and Washington and are based on data collected via NMFS Southwest Fisheries Science Center (SWFSC) ship-based surveys in 1991, 1993, 1996, 2001, 2005, 2008, and 2014. The surveys were conducted up to ~556 km from shore from June or August to November or December. The densities from NMFS SWFSC vessel-based surveys were corrected by the authors for both trackline detection probability and availability bias. Trackline detection probability bias is associated with diminishing sightability with increasing lateral distance from the trackline and is measured by $f(0)$. Availability bias refers to the fact that there is less than 100 percent probability of sighting an animal that is present along the survey trackline, and it is measured by $g(0)$. Abundance and density were not estimated for gray whales or harbor porpoises in the NMFS SWFSC surveys because their inshore habitats were inadequately covered in those studies. Gray whale density is derived from the abundance of gray whales that remain between Oregon and British Columbia in summer (updated based on abundance calculated by Calambokidis *et al.* 2014) and the area out to 43 km from shore, using the U.S. Navy (2010) method. Harbor porpoise densities are based on data from aerial line-transect surveys during 2007–2012 for the Northern Oregon/Washington Coast stock (Forney *et al.* 2014).

Systematic, offshore, at-sea survey data for pinnipeds are more limited than those for cetaceans. Densities for pinnipeds were calculated as the estimated number of animals at sea divided by the area encompassing their range. Densities for the Steller sea lion, California sea lion, northern elephant seal, and northern fur seal were calculated using the methods in U.S. Navy (2010) with updated abundance estimates from Carretta *et al.* (2016) and Muto *et al.* (2016), when appropriate. For the harbor seal, densities were calculated using the population

estimate for the Oregon/Washington Coastal stock and the range for that stock from Carretta *et al. (*2016).

In the *Federal Register* notice of the proposed IHA (82 FR 39276; August 17, 2017), areas encompassing the ranges of pinniped species, which were used to estimate pinniped densities, were based on areas reported in U.S. Navy (2010). However, after publication of the notice of the proposed IHA, the Commission noted in their comment letter that the best available data on areas encompassing the ranges of pinniped species in the project area is presented in U.S. Navy (2014). We have reviewed U.S. Navy (2014) and have revised densities in the final IHA from those shown in the proposed IHA accordingly, to reflect the best available information on areas encompassing the ranges of pinniped species. The estimates of the numbers of animals at sea that were used to estimate densities in the proposed IHA remains the best available information for all five pinniped species expected to occur in the survey area; thus, in revising estimated densities we used the updated areas from U.S. Navy 2014 (when updated areas were available), and the same estimates of the numbers of animals at sea as those that were used to estimate density in the proposed IHA. For three species (Steller sea lion, northern elephant seal, and northern fur seal) the areas reported in U.S. Navy (2014) were the same as those in U.S. Navy (2010); therefore, there was no need to revise densities for these species. For harbor seal and California sea lion, areas reported in U.S. Navy (2014) were different than those reported in U.S. Navy (2010); therefore, we have revised density estimates of these two species to reflect the best available information. Note that correction factors were applied in some cases in the calculations of density estimates for pinnipeds (see footnotes in Table 8).

There is some uncertainty related to the estimated density data and the assumptions used in their calculations, as with all density data estimates. However, the approach used is based on the best available data.

Take Calculation and Estimation

Here we describe how the information provided above is brought together to produce a quantitative take estimate. In order to estimate the number of marine mammals predicted to be exposed to sound levels that would result in Level A harassment or Level B harassment, radial distances from the airgun array to predicted isopleths corresponding to the Level A harassment threshold and Level B harassment threshold are calculated, as described above. Those radial distances are then used to calculate the area(s) around the airgun array predicted to be ensonified to sound levels that exceed the Level A harassment and Level B harassment thresholds. The area estimated to be ensonified to those thresholds in a single day of the survey is then calculated (Table 7), based on the areas predicted to be ensonified around the array and the estimated trackline distance traveled per day. This number is then multiplied by the number of survey days (*i.e.*, 5). The product is then multiplied by 1.25 to account for the additional 25 percent contingency, as described above. This results in an estimate of the total areas in square kilometers (km^2) expected to be ensonified to the Level A harassment and Level B harassment thresholds (Table 7). For purposes of Level B take calculations, areas estimated to be ensonified to Level A harassment thresholds are subtracted from total areas estimated to be ensonified to Level B harassment thresholds in order to avoid double counting the animals taken (*i.e.*, if an animal is taken by Level A harassment, it is not also counted as taken by Level B harassment). The marine mammals predicted to occur within these respective areas, based on estimated densities, are assumed to be incidentally taken. Areas estimated to be ensonified to the Level B

harassment threshold for the planned survey are shown in Table 7. Estimated takes for all marine mammal species are shown in Table 8.

Table 7. Areas (km^2) Estimated to be Ensonified to Level A and Level B Harassment Thresholds Over the Duration of the Survey.

Level B harassment threshold	**Level A harassment threshold**[1]				
All marine mammals	Low frequency cetaceans	Mid frequency cetaceans	High frequency cetaceans	Otariid Pinnipeds	Phocid Pinnipeds
1,276.25	21.1	2.6	96.2	1.2	13.9

Note: Estimated areas based on five survey days and include additional 25 percent contingency (effectively resulting in 6.25 survey days). Level A ensonified areas are estimated based on the greater of the distances calculated to Level A isopleths using dual criteria (SEL_{cum} and $_{peak}SPL$).

Take estimates for Dall's porpoise and harbor porpoise have been been revised from those reflected in the *Federal Register* notice of proposed IHA (82 FR 39276; August 17, 2017). For Dall's porpoise, we have adopted the Commission's suggestion that the take estimate should be based on the density for the species that was derived in BSS of 0–5 (58.3 animals per km^2) versus the density that was derived in BSS of 0–3 (54.4 animals per km^2) which was used in the take stimate shown in the proposed IHA, based on the fact that previous geophysical surveys in waters of northern California, Oregon, and Washington have occurred in BSSs of 0–7 during the same season. Additionally, for species for which Level A take is being authorized, the Commission correctly noted that Level A estimates should be subtracted from Level B estimates when calculating the total number of authorized takes (to avoid double counting the animals taken by Level A harassment, as described above); this step had mistakenly not been performed for the take estimates reflected in the proposed IHA. These revisions resulted in a revised estimate of 69 Level B takes (versus 68 as shown in the proposed IHA) and a revised estimate of 74 total takes (versus 73 as shown in the proposed IHA). Harbor porpoise takes were recalculated due to a mathematical error in the take estimate reflected in the proposed IHA, and

were also revised to avoid double counting of takes (as described for Dall's porpoise above). This resulted in a revised estimate of 552 Level B takes (versus 582) and a revised estimate of 596 total takes (versus 627).

Take estimates for harbor porpoise and California sea lion have been also been revised based on use of revised density estimates for these species as described above. As noted above, in response to concerns raised by the Commission, density estimates used to estimate take for harbor seal and California sea lion have been revised to reflect the best available information on the range of those species (represented by U.S. Navy (2014)). As areas representing the range of the species for harbor seal and California sea lion reported in U.S. Navy (2014) were greater than those reported in U.S. Navy (2010), and estimates of the numbers of animals at sea remained the same for both species, this resulted in lower estimated densities, and lower estimated take numbers, for both species. For Caifornia sea lion, density was revised from 283.3 animals per 1,000 km^2 to 33.3 animals per 1,000 km^2. This resulted in a revised take estimate of 43 takes by Level B harassment (versus the previous estimate of 362 takes by Level B harassment) (Table 8). For harbor seal, density was revised from 292 animals per 1,000 km^2 to 279 animals per 1,000 km^2. This resulted in a revised take estimate of 356 takes by Level B harassment; however, as Level A estimates are subtracted from Level B estimates when calculating the total number of authorized takes (to avoid double counting the animals taken by Level A harassment, as described above) the revised take estimate for harbor seals is 352 takes by Level B harassment and 4 takes by Level A harassment (versus the previous estimate of 367 takes by Level B harassment) (Table 8).

Table 8. Numbers of Potential Incidental Take of Marine Mammals Authorized.

Species	Density (# / 1,000 km^2)	Estimated and Authorized Level A	Estimated Level B Takes	Authorized Level B Takes	Total Authorized Takes	Total Authorized Level A and Level B takes as

		Takes				**a Percentage of Population**
Gray whale	2.6	0	4	4	4	< 0.1
Humpback whale	2.1	0	3	3	3	0.2
Minke whale	1.3	0	2	2	2	0.3
Sei whale [1]	0.4	0	1	2	2	0.4
Fin whale	4.2	0	6	6	6	< 0.1
Blue whale	0.3	0	1	1	1	< 0.1
Sperm whale [1]	0.9	0	2	6	6	0.3
Pygmy sperm whale	1.6	0	2	2	2	< 0.1
Killer whale [1] *West coast transient stock* *Eastern No. Pacific offshore stock*	0.9	0	2	8	8	 3.3 3.3
False killer whale[1]	0	0	0	5	5	0.3
Short-finned pilot whale [1]	0.2	0	1	18	18	2.2
Harbor porpoise *No.California / So. Oregon stock* *Northern Oregon/ Washington coast stock*	467.0	44	552	552	596	 1.7 2.7
Dall's porpoise	58.3	5	69	69	74	0.3
Bottlenose dolphin[1]	0	0	0	13	13	6.8
Striped dolphin[1]	7.7	0	10	109	109	3.7
Risso's dolphin[1]	11.8	0	16	28	28	4.4
Short-beaked common dolphin[1]	69.2	0	89	286	286	< 0.1
Pacific white sided dolphin[1]	40.7	0	52	62	62	2.3
Northern right whale dolphin[1]	46.4	0	60	63	63	2.5

Cuvier's beaked whale	2.8	0	4	4	4	< 0.1
Baird's beaked whale	10.7	0	14	14	14	1.7
Mesoplodont beaked whales[2]	1.2	0	2	2	2	2.9
Northern fur seal[3]	83.4	0	107	107	107	0.8
California sea lion[4]	33.3	0	43	43	43	< 0.1
Steller sea lion[5]	15.0	0	20	20	20	< 0.1
Harbor seal[6]	292.3	4	352	352	356	1.4
Northern elephant seal[7]	83.1	1	105	105	106	< 0.1

[1] The number of authorized takes (Level B harassment only) for these species has been increased from the estimated take to mean group size (as reported in Barlow (2016)).
[2] May be any of the following: Blainville's beaked whale, Perrin's beaked whale, Lesser beaked whale, Stejneger's beaked whale, Gingko-toothed beaked whale, or Hubb's beaked whale.
[3] Estimated density based on abundance of Eastern Pacific stock from Muto et al. (2016) plus California stock from Carretta et al. (2017) subtracting pups for Eastern Pacific stock (Muto *et al*. 2016) and subtracting pups for San Miguel Island (Carretta *et al.* 2017) as it was assumed that pups would not be at sea during the survey. Area representing range of the stock is 6,165,000 km^2 (U.S. Navy 2014).
[4] Estimated density based on abundance estimate from Jeffries et al. (2000). Area representing range of the stock is 150,000 km^2 (U.S. Navy 2014).
[5] Estimated density based on abundance estimate from Muto et al. (2016); abundance estimate was multiplied by 0.25, as an estimate of the percentage of the population at sea (Bonnell and Bowlby 1992; U.S. Navy 2014). Area representing range of the stock is 1,244,000 km^2 (U.S. Navy 2014).[6] Estimated density based on abundance estimate from Carretta et al. (2017); abundance estimate was multiplied by 0.35, as 35 percent of the population is estimated to be in the water at any given time (Huber et al. 2001; U.S. Navy 2014). Area representing range of the stock is 31,000 km^2 (U.S. Navy 2014).
[7] Estimated density based on abundance estimate from Carretta et al. (2017), with adult males assumed to be at rookeries subtracted from abundance estimate (U.S. Navy, 2014). Area representing range of the stock is 2,032,000 km^2 (U.S. Navy 2014).

Species with Take Estimates Less than Mean Group Size: Using the approach described above to estimate take, the take estimates for the sei whale, sperm whale, killer whale, short-finned pilot whale, false killer whale, bottlenose dolphin, short beaked common dolphin, striped dolphin, Pacific white sided dolphin, Risso's dolphin and Northern right whale dolphin were less than the average group sizes estimated for these species (Table 8). However, information on the social structures and life histories of these species indicates it is common for these species to be encountered in groups. The results of take calculations support the likelihood that SIO's survey is expected to encounter and to incidentally take these species, and we believe it is likely that these species may be encountered in groups, therefore it is reasonable to conservatively assume

that one group of each of these species will be taken during the planned survey. We therefore authorize the take of the average (mean) group size for these species and stocks to account for the possibility that SIO's survey encounters a group of any of these species or stocks (Table 8).

No density data were available for the false killer whale or the bottlenose dolphin in the planned survey area, as these species are not typically observed in the planned survey area (Carretta *et al*., 2017). However, we believe it is possible that these species may be encountered by SIO during the planned survey. Though false killer whales are a tropical species that is usually found in waters warmer than those typical of the planned survey area, they have been observed off the U.S. west coast during warm-water periods. Several sightings were made off California during 2014-2016, when waters were unusually warm, and historically there are very rare records farther north (pers. comm. K. Forney, NMFS Southwest Fisheries Science Center, to J. Carduner, NMFS, July 27, 2017). Bottlenose dolphins have not been observed off the coast of Oregon and Washington (Carretta *et al.*, 2017). However, they occur frequently off the coast of California, and they may range into Oregon and Washington waters during warm-water periods. (Carretta *et al.*, 2017). Though no density data are available, we believe it is reasonable to conservatively assume that SIO's planned survey may encounter and incidentally take false killer whales and bottlenose dolphins. We therefore authorize the take of the average (mean) group size for both species (Table 8).

It should be noted that the take numbers shown in Table 8 are believed to be conservative for several reasons. First, in the calculations of estimated take, 25 percent has been added in the form of operational survey days (equivalent to adding 25 percent to the planned line km to be surveyed) to account for the possibility of additional seismic operations associated with airgun testing, and repeat coverage of any areas where initial data quality is sub-standard. Additionally,

marine mammals would be expected to move away from a loud sound source that represents an aversive stimulus, potentially reducing the number of Level A takes. However, the extent to which marine mammals would move away from the sound source is difficult to quantify and is therefore not accounted for in take estimates shown in Table 8.

For some marine mammal species, we authorize a different number of incidental takes than the number of incidental takes requested by SIO (see Table 7 in the IHA application for requested take numbers). For instance, for several species, SIO increased the take request from the calculated take number to 1 percent of the estimated population size. However, we do not believe it is likely that 1 percent of the estimated population size of those species will be taken by SIO's planned survey, therefore we authorize take numbers as shows in Table 8, which we believe are based on the best available information.

To calculate distances to isopleths corresponding to Level A harassment thresholds using Peak SPL_{flat}, LDEO first ran the modeling for a single shot and then applied a high pass filter for each hearing group based on the group's generalized hearing range. A high pass filter is a type of band-pass filter, which pass frequencies within a defined range without reducing amplitude and attenuate frequencies outside that defined range (Yost 2007). LDEO ran the modeling both with and without the application of the high pass filter and SIO included information on isopleths corresponding to Level A harassment thresholds both with and without the high pass filter in their IHA application. The Technical Guidance referred to auditory weighting functions based on a generic band-pass filter (NMFS 2016). However, it is important to note that the two datasets relied upon to define peak SPL thresholds, either directly or as a surrogate means to derive thresholds for groups where no data are available (*i.e.*, a beluga exposed to seismic water gun and harbor porpoise exposed to a single airgun) did not use a filter of any kind (*i.e.*, thresholds

provided were flat across the entire spectrum of the sound source). Therefore, for the purposes of modeling isopleths corresponding to Level A harassment thresholds using Peak SPL_{flat}, NMFS believes that sound produced from the *Revelle* airgun array should be considered flat to result in no weighting/high pass filtering of any type at this time. Therefore, for the purposes of the take calculation, we rely on the distances to isopleths corresponding to Level A harassment thresholds using Peak SPL_{flat} based on modeling performed by LDEO without the high pass filter applied. Thus, the Level A take numbers shown in Table 8 for harbor porpoise, Dall's porpoise and harbor seal are higher than the Level A take numbers requested by SIO as they are the result of modeling of isopleths corresponding to Level A harassment thresholds using Peak SPL_{flat} with no weighting/high pass filtering applied. Level A take numbers for other species are not affected.

Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

1) the manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned) the likelihood of effective implementation (probability implemented as planned), and

2) the practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

SIO has reviewed mitigation measures employed during seismic research surveys authorized by NMFS under previous incidental harassment authorizations, as well as recommended best practices in Richardson *et al.* (1995), Pierson *et al.* (1998), Weir and Dolman (2007), Nowacek *et al*. (2013), Wright (2014), and Wright and Cosentino (2015), and has incorporated a suite of mitigation measures into their project description based on the above sources.

To reduce the potential for disturbance from acoustic stimuli associated with the activities, SIO will implement the following mitigation measures for marine mammals:

(1) Vessel-based visual mitigation monitoring;

(2) Establishment of an exclusion zone and buffer zone;

(3) Shutdown procedures;

(4) Ramp-up procedures; and

(5) Ship strike avoidance measures.

In addition to these measures, NMFS proposed the following additional mitigation measures:

(1) Shutdown for a killer whale observed at any distance; and

(2) Shutdown for a north Pacific right whale observed at any distance.

Vessel-based visual mitigation monitoring

Protected Species Observer (PSO) observations will take place during all daytime airgun operations and nighttime start ups (if applicable) of the airguns. If airguns are operating throughout the night, observations will begin 30 minutes prior to sunrise. If airguns are operating after sunset, observations will continue until 30 minutes following sunset. Following a shutdown for any reason, observations will occur for at least 30 minutes prior to the planned start of airgun operations. Observations will also occur for 30 minutes after airgun operations cease for any reason. Observations will also be made during daytime periods when the *Revelle* is underway without seismic operations, such as during transits, to allow for comparison of sighting rates and behavior with and without airgun operations and between acquisition periods. Airgun operations will be suspended when marine mammals are observed within, or about to enter, the designated Exclusion Zone (EZ) (as described below).

During seismic operations, at least three visual PSOs will be based aboard the *Revelle*. PSOs will be appointed by SIO with NMFS approval. During the majority of seismic operations, two PSOs will monitor for marine mammals around the seismic vessel. A minimum of one PSO must be on duty at all times when the array is active. PSO(s) will be on duty in shifts of duration no longer than 4 hours. Other crew will also be instructed to assist in detecting marine mammals and in implementing mitigation requirements (if practical). Before the start of the seismic survey, the crew will be given additional instruction in detecting marine mammals and implementing mitigation requirements.

The *Revelle* is a suitable platform from which PSOs will watch for marine mammals. The *Revelle* has been used for that purpose during the routine California Cooperative Oceanic Fisheries Investigations surveys. Observing stations are located at the 02 level, with the observer eye level at ~10.4 m above the waterline. At a forward-centered position on the 02 deck, the view is ~240º; an aft-centered view includes the 100-m radius area around the GI airguns. The observer eye level on the bridge is ~15 m above sea level. Standard equipment for marine mammal observers will be 7 x 50 reticule binoculars and optical range finders. At night, night-vision equipment will be available. The observers will be in communication with ship's officers on the bridge and scientists in the vessel's operations laboratory, so they can advise promptly of the need for avoidance maneuvers or seismic source shutdown.

The PSOs must have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements. PSO resumes have been be provided to NMFS for approval. At least one PSO must have a minimum of 90 days at-sea experience working as PSOs during a seismic survey. One "experienced" visual PSO will be designated as the lead for the entire protected species observation team. The lead will serve as primary point of contact for the vessel operator.

The PSOs must have successfully completed relevant training, including completion of all required coursework and passing a written and/or oral examination developed for the training program, and must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through

alternate training, including (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

Exclusion Zone and Buffer Zone

An EZ is a defined area within which occurrence of a marine mammal triggers mitigation action intended to reduce the potential for certain outcomes, *e.g.*, auditory injury, disruption of critical behaviors. The PSOs will establish a minimum EZ with a 100 m radius for the airgun array. The 100 m EZ will be based on radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). With certain exceptions (described below), if a marine mammal appears within, enters, or appears on a course to enter this zone, the acoustic source will be shut down (see Shut Down Procedures below).

The 100 m radial distance of the standard EZ is precautionary in the sense that it would be expected to contain sound exceeding peak pressure injury criteria for all marine mammal hearing groups (Table 6) while also providing a consistent, reasonably observable zone within which PSOs would typically be able to conduct effective observational effort. In this case, the 100 m radial distance would also be expected to contain sound that would exceed the Level A harassment threshold based on sound exposure level (SEL_{cum}) criteria for all marine mammal hearing groups (Table 6). In the 2011 Programmatic Environmental Impact Statement for marine scientific research funded by NSF or the U.S. Geological Survey (NSF-USGS 2011), Alternative B (the Preferred Alternative) conservatively applied a 100 m EZ for all low-energy acoustic sources in water depths >100 m, with low-energy acoustic sources defined as any towed acoustic

source with a single or a pair of clustered airguns with individual volumes of ≤250 in^3. Thus the 100 m EZ for this survey is consistent with the PEIS.

Our intent in prescribing a standard exclusion zone distance is to (1) encompass zones within which auditory injury could occur on the basis of instantaneous exposure; (2) provide additional protection from the potential for more severe behavioral reactions (*e.g.*, panic, antipredator response) for marine mammals at relatively close range to the acoustic source; (3) provide consistency for PSOs, who need to monitor and implement the EZ; and (4) define a distance within which detection probabilities are reasonably high for most species under typical conditions.

PSOs will also establish and monitor a 200 m buffer zone. During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) will be communicated to the operator to prepare for potential shutdown of the acoustic source. The buffer zone is discussed further under *Ramp Up Procedures* below. PSOs will also monitor the entire extent of the Level B zone, or as far as possible if the extent of the Level B zone is not visible.

Shutdown Procedures

If a marine mammal is detected outside the EZ but is likely to enter the EZ, and if the vessel's speed and/or course cannot be changed to avoid having the animal enter the EZ, the airguns will be shut down before the animal is within the EZ. Likewise, if a marine mammal is already within the EZ when first detected, the airguns will be shut down immediately.

Following a shutdown, airgun activity will not resume until the marine mammal has cleared the 100 m EZ. The animal will be considered to have cleared the 100 m EZ if the following conditions have been met:

- it is visually observed to have departed the 100 m EZ, or
- it has not been seen within the 100 m EZ for 15 minutes in the case of small odontocetes, or
- it has not been seen within the 100 m EZ for 30 minutes in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales.

This shutdown requirement will be in place for all marine mammals, with the exception of small delphinoids under certain circumstances. As defined here, the small delphinoid group is intended to encompass those members of the Family Delphinidae most likely to voluntarily approach the source vessel for purposes of interacting with the vessel and/or airgun array (*e.g.*, bow riding). This exception to the shutdown requirement will apply solely to specific genera of small dolphins — *Tursiops, Stenella, Delphinus, Lagenorhynchus* and *Lissodelphis* — and will only apply if the animals were traveling, including approaching the vessel. If, for example, an animal or group of animals is stationary for some reason (*e.g.*, feeding) and the source vessel approaches the animals, the shutdown requirement applies. An animal with sufficient incentive to remain in an area rather than avoid an otherwise aversive stimulus could either incur auditory injury or disruption of important behavior. If there is uncertainty regarding identification (*i.e.*, whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, the shutdown will be implemented.

We include this small delphinoid exception because shutdown requirements for small delphinoids under all circumstances represent practicability concerns without likely commensurate benefits for the animals in question. Small delphinoids are generally the most commonly observed marine mammals in the specific geographic region and would typically be the only marine mammals likely to intentionally approach the vessel. As described below,

auditory injury is extremely unlikely to occur for mid-frequency cetaceans (*e.g.*, delphinids), as this group is relatively insensitive to sound produced at the predominant frequencies in an airgun pulse while also having a relatively high threshold for the onset of auditory injury (*i.e.*, permanent threshold shift). Please see "Potential Effects of the Specified Activity on Marine Mammals" above for further discussion of sound metrics and thresholds and marine mammal hearing.

A large body of anecdotal evidence indicates that small delphinoids commonly approach vessels and/or towed arrays during active sound production for purposes of bow riding, with no apparent effect observed in those delphinoids (*e.g.*, Barkaszi *et al*., 2012). The potential for increased shutdowns resulting from such a measure would require the *Revelle* to revisit the missed track line to reacquire data, resulting in an overall increase in the total sound energy input to the marine environment and an increase in the total duration over which the survey is active in a given area. Although other mid-frequency hearing specialists (*e.g.*, large delphinoids) are no more likely to incur auditory injury than are small delphinoids, they are much less likely to approach vessels. Therefore, retaining a shutdown requirement for large delphinoids would not have similar impacts in terms of either practicability for the applicant or corollary increase in sound energy output and time on the water. We do anticipate some benefit for a shutdown requirement for large delphinoids in that it simplifies somewhat the total range of decision-making for PSOs and may preclude any potential for physiological effects other than to the auditory system as well as some more severe behavioral reactions for any such animals in close proximity to the source vessel.

At any distance, shutdown of the acoustic source will also be required upon observation of any of the following:

- a killer whale;
- a large whale (*i.e.*, sperm whale or any baleen whale) with a calf;
- a north Pacific right whale; or
- an aggregation of large whales of any species (*i.e.*, sperm whale or any baleen whale) that does not appear to be traveling (*e.g.*, feeding, socializing, etc.).

These are the only potential situations that would require shutdown of the array for marine mammals observed beyond the 100 m EZ. Killer whales belonging to the Southern Resident distinct population segment (DPS) are not expected to occur in the area of the planned survey as the easternmost track lines of the planned survey (those that approach nearest to shore) are further west than the migratory range of the Southern Resident stock off Oregon and southern Washington (pers. comm., B. Hanson, NMFS Northwest Fishery Science Center to J. Carduner, NMFS Office of Protected Resources (OPR), April 12, 2017). As the Eastern North Pacific Southern Resident stock would be expected to occur closer to shore than the planned survey area, the survey is not expected to encounter any individuals from this stock. However, as the known migratory range of the Southern Resident DPS occurs near the planned survey area, and due to the precarious conservation status of the Southern Resident killer whale DPS, NMFS believes it is reasonable to implement measures that are conservative and also practicable in order to prevent the potential for a Southern Resident killer whale to be exposed to airgun sounds. Thus the requirement to shut down the array upon observation of a killer whale at any distance is designed to avoid any potential for harassment of any Southern Resident killer whales.

As described above, we do not expect the survey to encounter a north Pacific right whale and take of north Pacific right whales is not authorized. However, in the extremely rare event

that a north Pacific right whale was observed at any distance, the array would be shut down and would not be activated until 30 minutes had elapsed since the most recent sighting.

Ramp-up Procedures

Ramp-up of an acoustic source is intended to provide a gradual increase in sound levels following a shutdown, enabling animals to move away from the source if the signal is sufficiently aversive prior to its reaching full intensity. Ramp-up will be required after the array is shut down for any reason. Ramp-up will begin with the activation of one 45 in^3 airgun, with the second 45 in^3 airgun activated after 5 minutes.

PSOs are required to monitor during ramp-up. During ramp up, the PSOs will monitor the EZ, and if marine mammals were observed within or approaching the 100 m EZ, a shutdown will be implemented as though the full array were operational. If airguns have been shut down due to PSO detection of a marine mammal within or approaching the 100 m EZ, ramp-up will not be initiated until all marine mammals have cleared the EZ, during the day or night. Criteria for clearing the EZ will be as described above.

Thirty minutes of pre-clearance observation are required prior to ramp-up for any shutdown of longer than 30 minutes (*i.e.*, if the array were shut down during transit from one line to another). This 30 minute pre-clearance period may occur during any vessel activity (*i.e.*, transit). If a marine mammal were observed within or approaching the 100 m EZ during this pre-clearance period, ramp-up will not be initiated until all marine mammals cleared the EZ. Criteria for clearing the EZ will be as described above. If the airgun array has been shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for a period of less than 30 minutes, it may be activated again without ramp-up if PSOs have maintained constant visual observation and no detections of any marine mammal have occurred within the EZ or buffer zone. Ramp-up will be

planned to occur during periods of good visibility when possible. However, ramp-up is allowed at night and during poor visibility if the 100 m EZ and 200 m buffer zone have been monitored by visual PSOs for 30 minutes prior to ramp-up.

The operator will be required to notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed. The operator must provide information to PSOs documenting that appropriate procedures were followed. Following deactivation of the array for reasons other than mitigation, the operator is required to communicate the near-term operational plan to the lead PSO with justification for any planned nighttime ramp-up.

Speed or Course Alteration

If a marine mammal is detected outside the EZ, based on its position and the relative motion, is likely to enter the EZ, the vessel's speed and/or direct course could be changed. This will be done if operationally practicable while minimizing the effect on the planned science objectives. The activities and movements of the marine mammal (relative to the seismic vessel) will then be closely monitored to determine whether the animal is approaching the EZ. If the animal appears likely to enter the EZ, a shutdown of the seismic source will cocur. Typically, during seismic operations, the source vessel is unable to change speed or course and one or more alternative mitigation measures (as described above) will need to be implemented.

Based on our evaluation of the mitigation measures as described above, NMFS has determined that the mitigation measures provide the means effecting the least practicable impact

on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth, requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the planned action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.*, presence, abundance, distribution, density);
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) affected species (*e.g.*, life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.*, age, calving or feeding areas);

- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors;
- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks;
- Effects on marine mammal habitat (*e.g.*, marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat); and
- Mitigation and monitoring effectiveness.

SIO submitted a marine mammal monitoring and reporting plan in section XIII of their IHA application. Monitoring that is designed specifically to facilitate mitigation measures, such as monitoring of the EZ to inform potential shutdowns of the airgun array, are described above and are not repeated here.

SIO's monitoring and reporting plan includes the following measures:

Vessel-Based Visual Monitoring

As described above, PSO observations will take place during daytime airgun operations and nighttime start ups (if applicable) of the airguns. During seismic operations, three visual PSOs will be based aboard the *Revelle*. PSOs will be appointed by SIO with NMFS approval. During the majority of seismic operations, one PSO will monitor for marine mammals around the seismic vessel. PSOs will be on duty in shifts of duration no longer than 4 hours. Other crew will also be instructed to assist in detecting marine mammals and in implementing mitigation requirements (if practical). During daytime, PSOs will scan the area around the vessel systematically with reticle binoculars (*e.g.*, 7×50 Fujinon), Big-eye binoculars (25×150), and with the naked eye.

PSOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data will be used to estimate numbers of animals potentially 'taken' by harassment (as defined in the MMPA). They will also provide information needed to order a shutdown of the airguns when a marine mammal is within or near the EZ. When a sighting is made, the following information about the sighting will be recorded:

1. Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (*e.g.*, none, avoidance, approach, paralleling, etc.), and behavioral pace.

2. Time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare.

All observations and shutdowns will be recorded in a standardized format. Data will be entered into an electronic database. The accuracy of the data entry will be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database. These procedures will allow initial summaries of data to be prepared during and shortly after the field program and will facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving. The time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare will also be recorded at the start and end of each observation watch, and during a watch whenever there is a change in one or more of the variables.

Results from the vessel-based observations will provide:

1. The basis for real-time mitigation (airgun shutdown);

2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS;

3. Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted;

4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity; and

5. Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Reporting

A report will be submitted to NMFS within 90 days after the end of the cruise. The report will describe the operations that were conducted and sightings of marine mammals near the operations. The report will provide full documentation of methods, results, and interpretation pertaining to all monitoring. The 90-day report will summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). The report will also include estimates of the number and nature of exposures that occurred above the harassment threshold based on PSO observations, including an estimate of those on the trackline but not detected.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of takes alone

is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

To avoid repetition, our analysis applies to all the species listed in Table 1, given that NMFS expects the anticipated effects of the planned seismic survey to be similar in nature. Where there are meaningful differences between species or stocks, or groups of species, in anticipated individual responses to activities, impact of expected take on the population due to differences in population status, or impacts on habitat, NMFS has identified species-specific factors to inform the analysis.

NMFS does not anticipate that serious injury or mortality will occur as a result of SIO's planned seismic survey, even in the absence of mitigation. Thus the authorization does not authorize any mortality. As discussed in the *Potential Effects* section, non-auditory physical effects, stranding, and vessel strike are not expected to occur.

We authorize a limited number of instances of Level A harassment (Table 8) for four species. However, we believe that any PTS incurred in marine mammals as a result of the

planned activity will be in the form of only a small degree of PTS, not total deafness, and would be unlikely to affect the fitness of any individuals, because of the constant movement of both the *Revelle* and of the marine mammals in the project area, as well as the fact that the vessel is not expected to remain in any one area in which individual marine mammals would be expected to concentrate for an extended period of time (*i.e.*, since the duration of exposure to loud sounds will be relatively short). Also, as described above, we expect that marine mammals are likely to move away from a sound source that represents an aversive stimulus, especially at levels that would be expected to result in PTS, given sufficient notice of the *Revelle's* approach due to the vessel's relatively low speed when conducting seismic surveys. We expect that the majority of takes will be in the form of short-term Level B behavioral harassment in the form of temporary avoidance of the area or decreased foraging (if such activity were occurring), reactions that are considered to be of low severity and with no lasting biological consequences (*e.g.*, Southall *et al*., 2007).

Potential impacts to marine mammal habitat were discussed previously in this document (see *Potential Effects of the Specified Activity on Marine Mammals and their Habitat*). Marine mammal habitat may be impacted by elevated sound levels, but these impacts will be temporary. Feeding behavior is not likely to be significantly impacted, as marine mammals appear to be less likely to exhibit behavioral reactions or avoidance responses while engaged in feeding activities (Richardson *et al*., 1995). Prey species are mobile and are broadly distributed throughout the project area; therefore, marine mammals that may be temporarily displaced during survey activities are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise. Because of the temporary nature of the disturbance, the availability of similar habitat and resources in the surrounding area, and the lack of important or

unique marine mammal habitat, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations. In addition, there are no mating or calving areas known to be biologically important to marine mammals within the planned project area.

The activity is expected to impact a very small percentage of all marine mammal stocks affected by SIO's planned survey (less than 7 percent each for all marine mammal stocks). Additionally, the acoustic "footprint" of the planned survey will be very small relative to the ranges of all affected marine mammals . Sound levels will increase in the marine environment in a relatively small area surrounding the vessel compared to the range of the marine mammals within the planned survey area. The seismic array will be active 24 hours per day throughout the duration of the planned survey. However, the very brief overall duration of the planned survey (five days) will further limit potential impacts that may occur as a result of the planned activity. As noted above, take estimates for four species have been revised since we published the proposed IHA. Our analysis reflects these revised numbers (Table 8).

The mitigation measures are expected to reduce the number and/or severity of takes by allowing for detection of marine mammals in the vicinity of the vessel by visual and acoustic observers, and by minimizing the severity of any potential exposures via shutdowns of the airgun array. Based on previous monitoring reports for substantially similar activities that have been previously authorized by NMFS, we expect that the mitigation measures will be effective in preventing at least some extent of potential PTS in marine mammals that may otherwise occur in the absence of the mitigation measures.

Of the marine mammal species under our jurisdiction that are likely to occur in the project area, the following species are listed as endangered under the ESA: humpback, blue, fin,

sei, and sperm whales. Population estimates for humpback whales for the North Pacific have increased substantially from 1,200 in 1966 to approximately 18,000 - 20,000 whales in 2004 to 2006 (Calambokidis *et al*. 2008) indicating a growth rate of 6-7 percent (Carretta *et al*., 2017). There are currently insufficient data to determine population trends for blue, fin, sei, and sperm whales (Carretta *et al*., 2017); however, we are proposing to authorize very small numbers of takes for these species (Table 8), relative to their population sizes, therefore we do not expect population-level impacts to any of these species. The other marine mammal species that may be taken by harassment during SIO's seismic survey are not listed as threatened or endangered under the ESA. There is no designated critical habitat for any ESA-listed marine mammals within the project area; and of the non-listed marine mammals for which we authorize take, none are considered "depleted" or "strategic" by NMFS under the MMPA.

NMFS concludes that exposures to marine mammal species and stocks due to SIO's planned seismic survey will result in only short-term (temporary and short in duration) effects to individuals exposed, or some small degree of PTS to a very small number of individuals of four species.. Animals may temporarily avoid the immediate area, but are not expected to permanently abandon the area. Major shifts in habitat use, distribution, or foraging success are not expected. NMFS does not anticipate the take estimates to impact annual rates of recruitment or survival.

In summary and as described above, the following factors primarily support our determination that the impacts resulting from this activity are not expected to adversely affect the marine mammal species or stocks through effects on annual rates of recruitment or survival:

- No mortality is anticipated or authorized;

- The anticipated impacts of the planned activity on marine mammals will primarily be temporary behavioral changes due to avoidance of the area around the survey vessel. The relatively short duration of the planned survey (5 days) will further limit the potential impacts of any temporary behavioral changes that may occur;
- The number of instances of PTS that may occur are expected to be very small in number (Table 8). Instances of PTS that are incurred in marine mammals would be of a low level, due to constant movement of the vessel and of the marine mammals in the area, and the nature of the survey design (not concentrated in areas of high marine mammal concentration);
- The availability of alternate areas of similar habitat value for marine mammals to temporarily vacate the survey area during the planned survey to avoid exposure to sounds from the activity;
- The planned survey area does not contain areas of significance for feeding, mating or calving;
- The potential adverse effects on fish or invertebrate species that serve as prey species for marine mammals from the planned survey would be temporary and spatially limited;
- The mitigation measures, including visual and acoustic monitoring and shutdowns, are expected to minimize potential impacts to marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the monitoring and mitigation measures, NMFS finds that the total marine mammal take from the planned activity will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under Section 101(a)(5)(D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers; so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities. Table 8 provides numbers of take by Level A harassment and Level B harassment authorized. These are the numbers we use for purposes of the small numbers analysis.

The numbers of marine mammals that we authorize to be taken, for all species and stocks, would be considered small relative to the relevant stocks or populations (less than 7 percent for all species and stocks). Based on the analysis contained herein of the planned activity (including the mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS finds that small numbers of marine mammals will be taken relative to the population size of the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks will not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

Section 7(a)(2) of the Endangered Species Act of 1973 (16 U.S.C. § 1531 *et seq*.) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. To ensure ESA compliance for the issuance of IHAs, NMFS consults internally, in this case with the ESA Interagency Cooperation Division, whenever we propose to authorize take for endangered or threatened species.

The NMFS Permits and Conservation Division are authorizing the incidental take of 5 species of marine mammals which are listed under the ESA: the humpback whale (Mexico DPS), sei whale, fin whale, blue whale and sperm whale. Under Section 7 of the ESA, we initiated consultation with the NMFS OPR Interagency Cooperation Division for the issuance of this IHA. In September, 2017, the NMFS OPR Interagency Cooperation Division issued a Biological Opinion with an incidental take statement, which concluded that the issuance of the IHA was not likely to jeopardize the continued existence of the humpback whale (Mexico DPS), sei whale, fin whale, blue whale and sperm whale. The Biological Opinion also concluded that the issuance of the IHA would not destroy or adversely modify designated critical habitat for these species.

Authorization

NMFS has issued an IHA to the SIO for the potential harassment of small numbers of 27

marine mammal species incidental to a low-energy marine geophysical survey in the northeast Pacific Ocean, provided the previously mentioned mitigation, monitoring and reporting requirements are incorporated.

Dated: October 19, 2017.

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Donna S. Wieting,

Director, Office of Protected Resources,

National Marine Fisheries Service.

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